EXHIBIT 11

Exhibit 11

US006542585B2

(12) United States Patent
Goodman

(10) Patent No.: US 6,542,585 B2
(45) Date of Patent: *Apr. 1, 2003

(54) DISTRIBUTED SPLITTER FOR DATA TRANSMISSION OVER TWISTED WIRE PAIRS

(75) Inventor: David D. Goodman, Arlington, VA (US)

(73) Assignee: Inline Connection Corporation, Arlington, VA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: 10/125,266

(22) Filed: Apr. 18, 2002

(65) Prior Publication Data

US 20020110229 A1 Aug. 15, 2002

Related U.S. Application Data

(63) Continuation of application No. 09/874,733, filed on Jun. 5, 2001, which is a continuation of application No. 09/362,180, filed on Jul. 27, 1999, now Pat. No. 6,243,446, which is a continuation of application No. 09/191,168, filed on Nov. 13, 1998, now Pat. No. 6,185,284, which is a continuation of application No. 08/814,837, filed on Mar. 11, 1997, now Pat. No. 5,844,596, which is a continuation of application No. 08/673,577, filed on Jul. 1, 1996, now abandoned, which is a continuation of application No. 08/545,937, filed on Oct. 20, 1995, now abandoned, which is a continuation of application No. 08/372,561, filed on Jan. 13, 1995, now abandoned, which is a continuation of application No. 08/245,759, filed on May 18, 1994, now abandoned, which is a continuation of application No. 08/115,930, filed on Aug. 31, 1993, now abandoned, which is a continuation of application No. 07/802,738, filed on Dec. 5, 1991, now abandoned, which is a continuation-in-part of application No. 07/688,864, filed on Apr. 19, 1991, now abandoned, which is a continuation of application No. 07/379,751, filed on Jul. 14, 1989, now Pat. No. 5,010,399.

(51) Int. Cl.[7] H04M 11/00

(52) U.S. Cl. 379/93.01; 379/90.01

(58) Field of Search 379/90.01, 102.01–102.03, 379/93.17, 93.26, 93.28, 93.37, 93.01; 348/14.01, 14.08–14.13, 734

(56) References Cited

U.S. PATENT DOCUMENTS

3,723,653 A 3/1973 Tatsuzawa
3,937,889 A 2/1976 Bell

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

EP 062442 10/1982

(List continued on next page.)

OTHER PUBLICATIONS

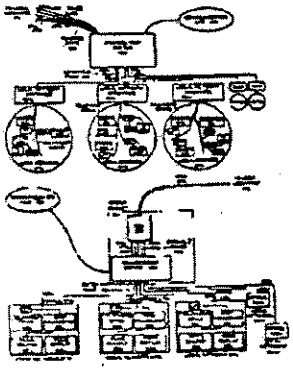
*Waring, David L., The Asymmetrical Digital Subscriber Line (ADSL): A New Transport Technology for Delivery Wideband Capabilities to the Residence), IEEE Globecom 1991.

Primary Examiner—Wing Fu Chan
(74) *Attorney, Agent, or Firm*—Hale & Dorr LLP

(57) ABSTRACT

A system that provides video signal communication between a source of the video signal and a plurality of units that include destinations of the video signal includes an interface coupled to the source and to telephone lines, each of which serves at least one of the units and carries voice signals to and from one or more telephones coupled to the telephone line at said unit. The interface receives the video signal from the source, and transmits the received video signal onto at least one of the telephone lines in a selected frequency range that is different from frequencies at which the voice signals are carried on that telephone line. This causes the video signal to be coupled to a receiver which is connected to the telephone line at the unit served by that line and is adapted to recover the video signal from the telephone line and apply it to one or more of the destinations at the unit. The source is a cable (e.g., electrical or fibre optic) that is linked to the interface and that carries a plurality of video signals. The destinations are, e.g., televisions. The units can be residences (such as individual houses or apartments in an apartment building) or offices in an office building.

9 Claims, 25 Drawing Sheets



U.S. PATENT DOCUMENTS

3,974,337	A	8/1976	Takuzawa
3,992,589	A	11/1976	Kuegler
4,054,910	A	10/1977	Chou
4,302,629	A	11/1981	Foulkes
4,328,579	A	5/1982	Hashimoto
4,509,211	A	4/1985	Robbins
4,546,212	A	10/1985	Crowder
4,608,686	A	8/1986	Barsellotti
4,670,870	A	6/1987	Sato
4,679,227	A	7/1987	Hughes
4,709,412	A	11/1987	Seymour
4,757,495	A	7/1988	Decker
4,757,497	A	7/1988	Beierle
4,766,402	A	8/1988	Crane
4,776,006	A	10/1988	Comerford
4,785,448	A	11/1988	Reichert
4,785,472	A	11/1988	Shapiro
4,799,213	A	1/1989	Fitzgerald
4,807,225	A	2/1989	Fitch
4,825,435	A	4/1989	Annodaeo
4,829,570	A	5/1989	Schotz
4,849,811	A	7/1989	Kleinerman
4,882,747	A	11/1989	Williams
4,885,803	A	12/1989	Hermann
4,890,316	A	12/1989	Walsh
4,893,326	A	1/1990	Duran
4,918,688	A	4/1990	Krause
4,924,492	A	5/1990	Gillis
4,949,187	A	8/1990	Cohen
4,953,160	A	8/1990	Gupta
4,955,048	A	9/1990	Iwamura
4,985,892	A	1/1991	Camarata
5,010,399	A	4/1991	Goodman
5,025,443	A	6/1991	Gupta
5,036,513	A	7/1991	Greenblatt
5,089,886	A	2/1992	Grandmougin
5,095,497	A	3/1992	Aman
5,247,347	A	9/1993	Litteral
5,283,637	A	2/1994	Goolcharan
5,844,596	A	12/1998	Goodman
5,929,896	A	7/1999	Goodman
5,949,476	A	9/1999	Goodman
6,185,284	B1 *	2/2001	Goodman 379/93.01
6,243,446	B1 *	6/2001	Goodman 379/93.01

FOREIGN PATENT DOCUMENTS

GB	2166322	4/1986
GB	2166328	4/1986
JP	127358	1/1989
WO	WO8805979	8/1988
WO	WO9107018	5/1991

* cited by examiner

FIG. 1a

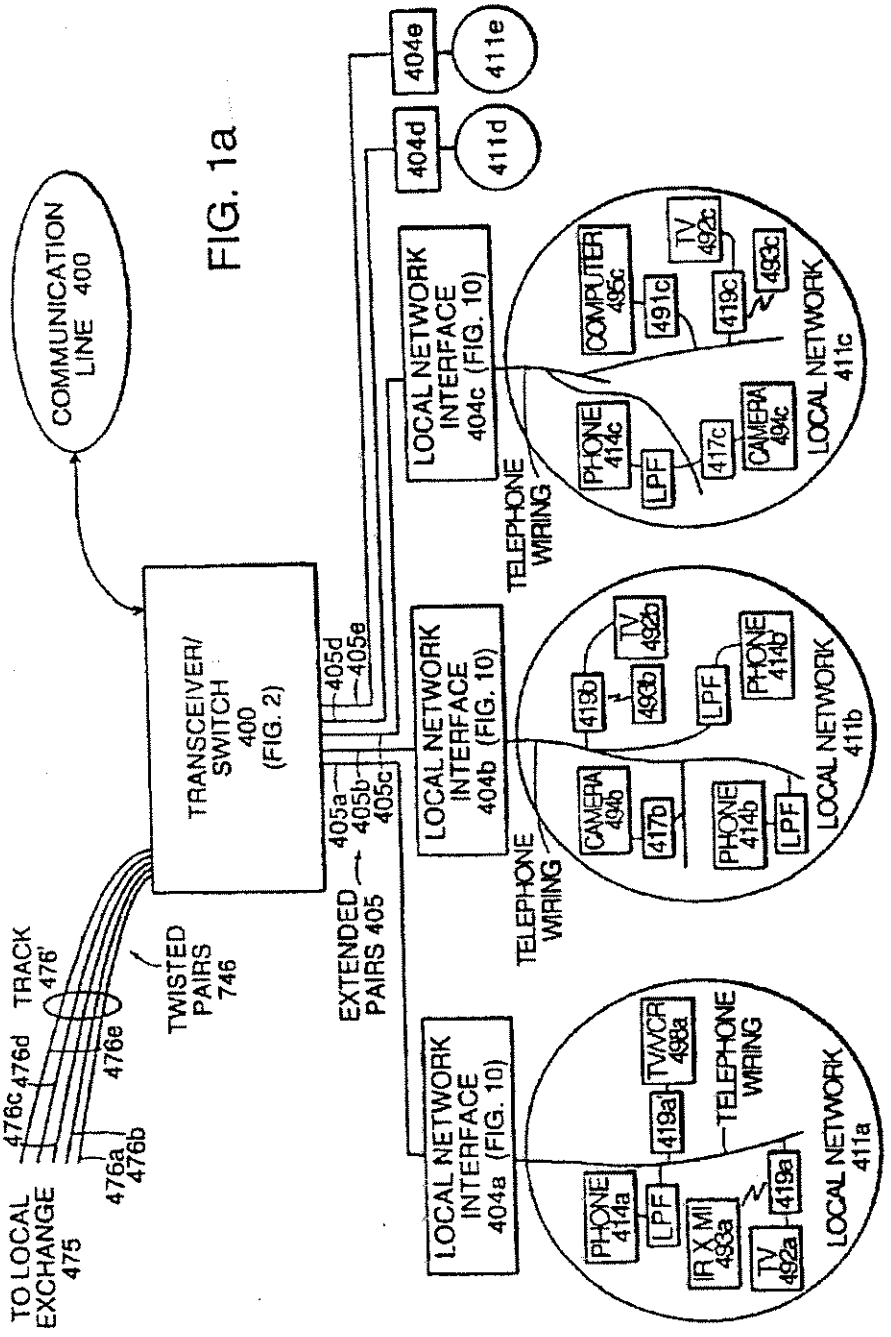

COMMUNICATION LINE 400
TRANSCEIVER/ SWITCH 400 (FIG. 2)
TO LOCAL EXCHANGE 475
TRACK 476'
476c 476d 476e 476a 476b
TWISTED PAIRS 746
EXTENDED PAIRS 405
405a 405b 405c 405d 405e
LOCAL NETWORK INTERFACE 404a (FIG. 10)
LOCAL NETWORK INTERFACE 404b (FIG. 10)
LOCAL NETWORK INTERFACE 404c (FIG. 10)
404d 404e
411d 411e
TELEPHONE WIRING
LOCAL NETWORK 411a
PHONE 414a
LPF
IR X MI 493a
TV 492a
419a
TV/VCR 493a
419a
TELEPHONE WIRING
LOCAL NETWORK 411b
CAMERA 494b
417b
PHONE 414b
LPF
419b
493b
TV 492b
LPF
PHONE 414b
LOCAL NETWORK 411c
PHONE 414c
LPF
417c
CAMERA 494c
COMPUTER 495c
491c
419c
493c
TV 492c

FIG. 1b

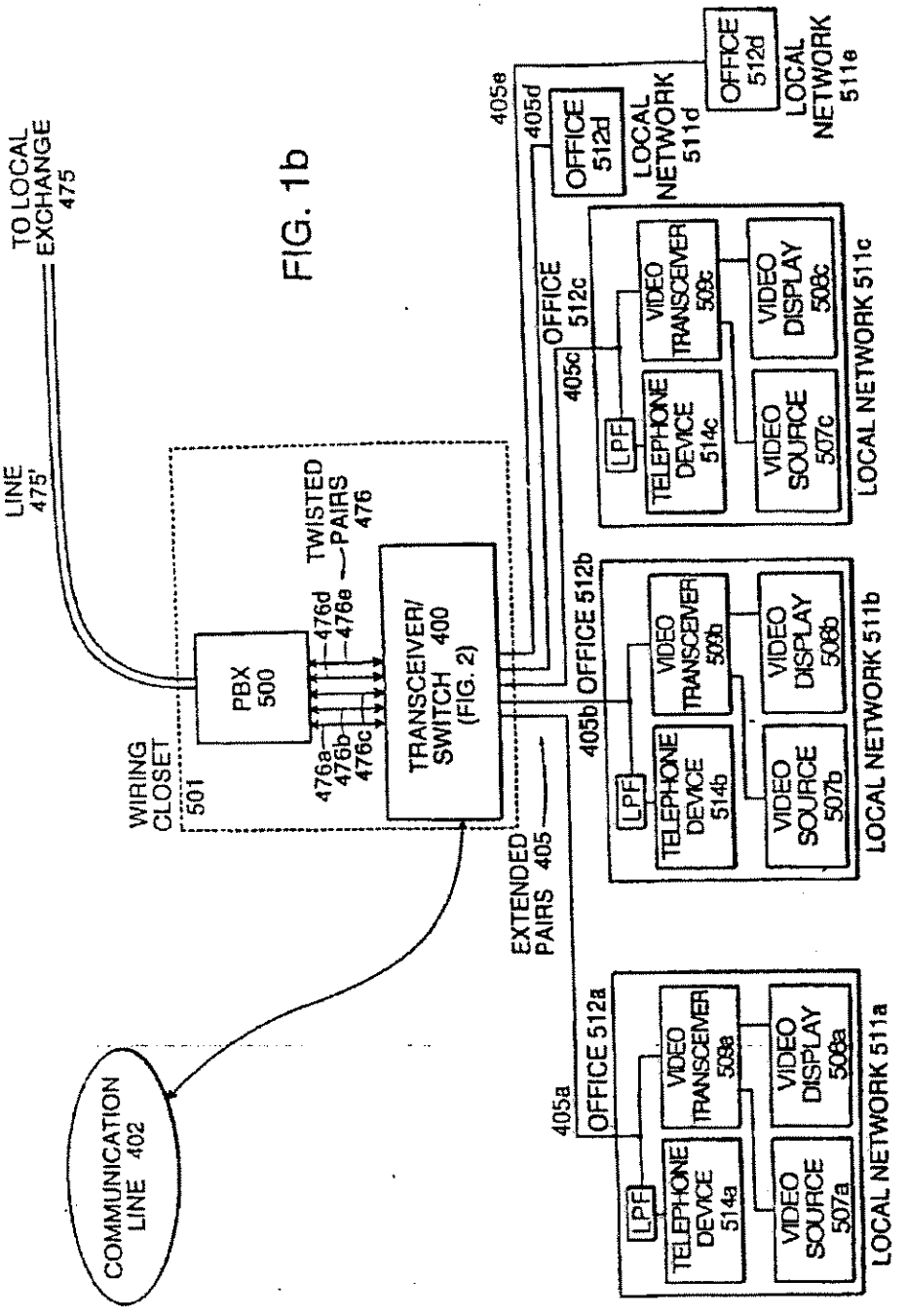

TO LOCAL EXCHANGE 475
LINE 475'
WIRING CLOSET 501
PBX 500
TWISTED PAIRS 476
476a
476b
476c
476d
476e
TRANSCEIVER/ SWITCH 400 (FIG. 2)
COMMUNICATION LINE 402
EXTENDED PAIRS 405
405a
405b
405c
405d
405e
OFFICE 512a
OFFICE 512b
OFFICE 512c
OFFICE 512d
OFFICE 512e
LOCAL NETWORK 511a
LOCAL NETWORK 511b
LOCAL NETWORK 511c
LOCAL NETWORK 511d
LOCAL NETWORK 511e
LPF
TELEPHONE DEVICE 514a
TELEPHONE DEVICE 514b
TELEPHONE DEVICE 514c
VIDEO TRANSCEIVER 509a
VIDEO TRANSCEIVER 509b
VIDEO TRANSCEIVER 509c
VIDEO DISPLAY 508a
VIDEO DISPLAY 508b
VIDEO DISPLAY 508c
VIDEO SOURCE 507a
VIDEO SOURCE 507b
VIDEO SOURCE 507c

FIG. 2

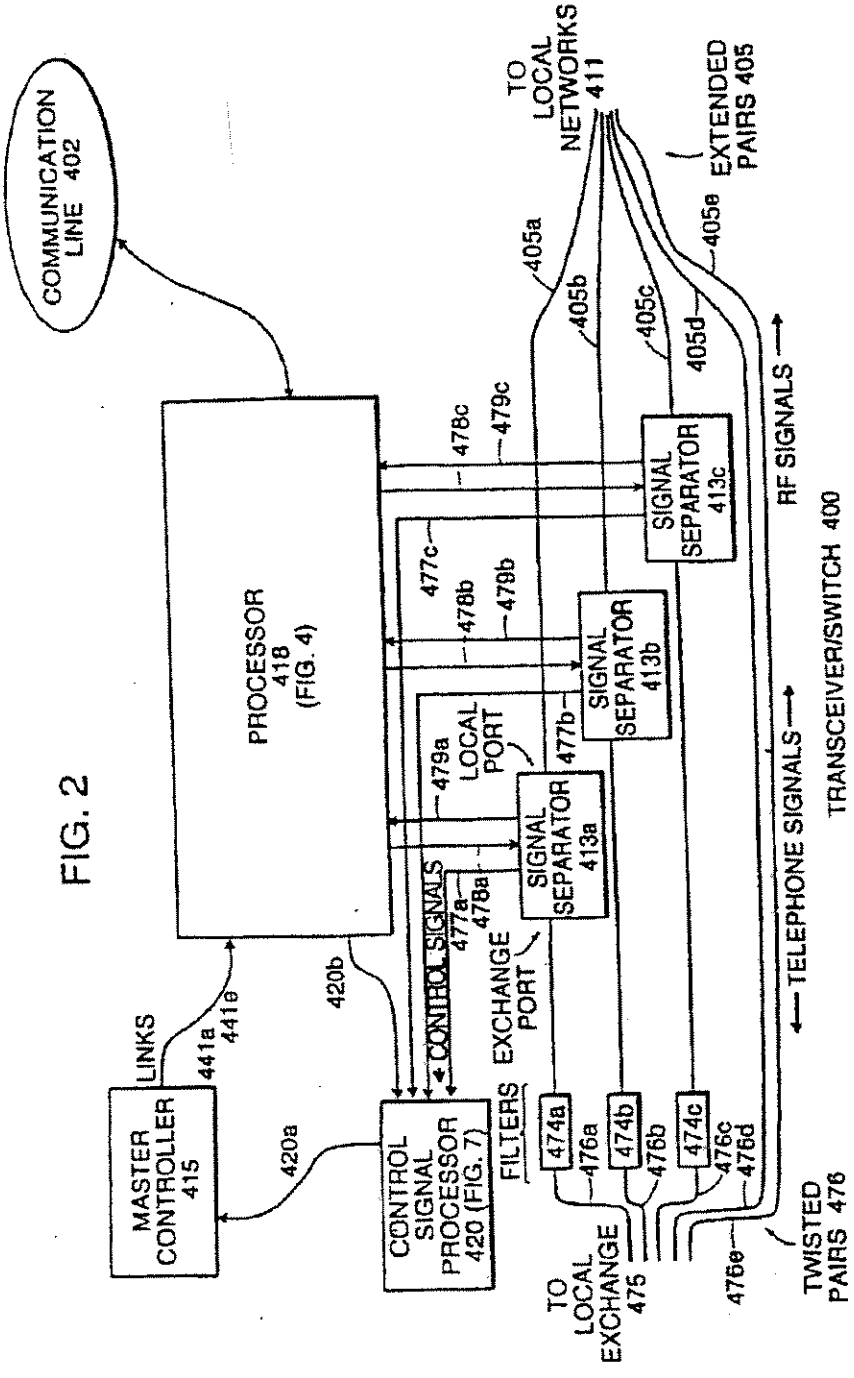
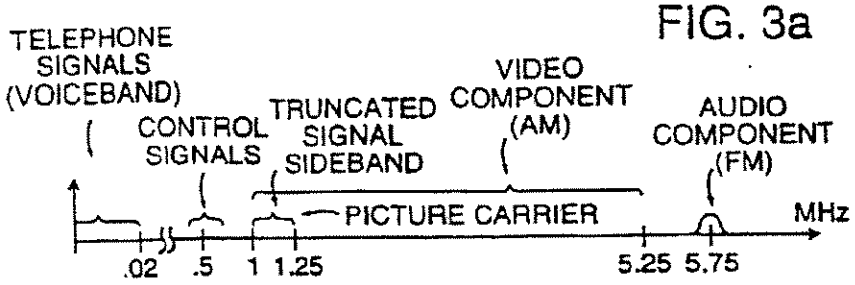
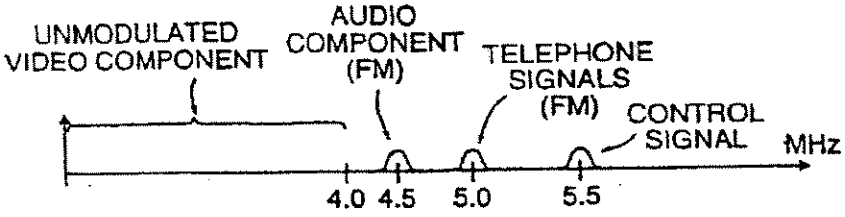

COMMUNICATION LINE 402
PROCESSOR 418 (FIG. 4)
TO LOCAL NETWORKS 411
EXTENDED PAIRS 405
405a
405b
405c
405d
405e
478c
479c
477c
478b
479b
477b
479a
LOCAL PORT
SIGNAL SEPARATOR 413c
SIGNAL SEPARATOR 413b
SIGNAL SEPARATOR 413a
RF SIGNALS
TELEPHONE SIGNALS
TRANSCEIVER/SWITCH 400
CONTROL SIGNALS
477a
478a
EXCHANGE PORT
FILTERS
474a
474b
474c
476a
476b
476c
476d
476e
TWISTED PAIRS 476
TO LOCAL EXCHANGE 475
LINKS
441a
441e
420b
420a
MASTER CONTROLLER 415
CONTROL SIGNAL PROCESSOR 420 (FIG. 7)

FIG. 3a



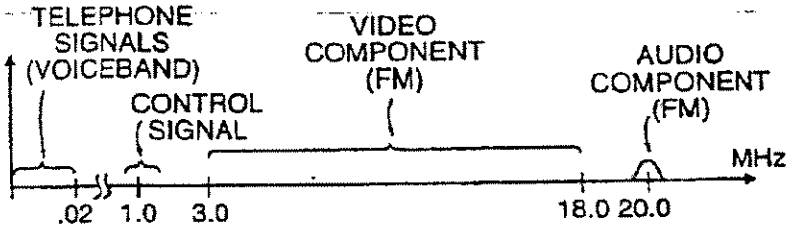
SPECTRUM OF AN AMPLITUDE MODULATED NTSC SIGNAL NEAR VOICEBAND

FIG. 3b



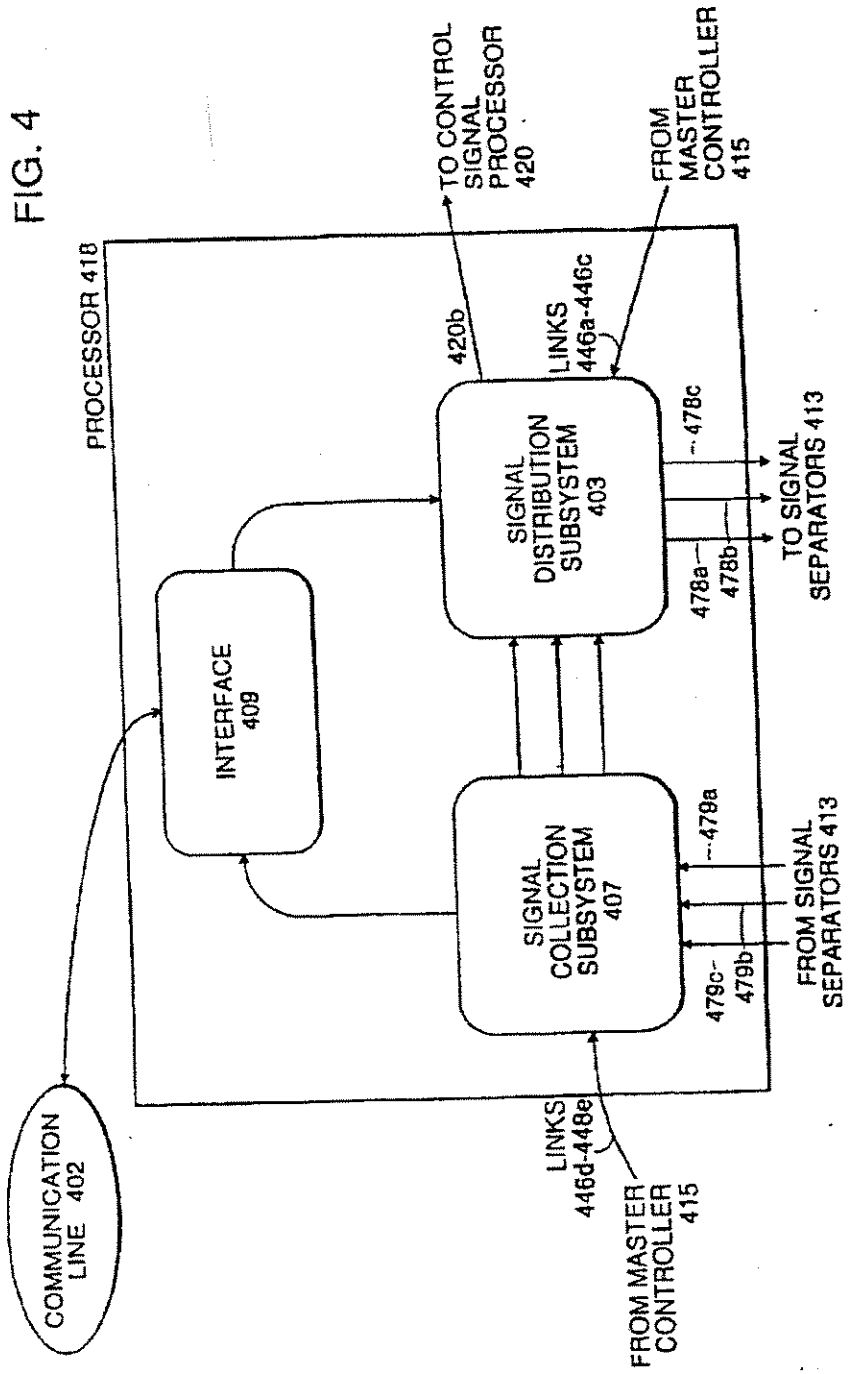
SPECTRUM OF AN NTSC SIGNAL TRANSMITTING AT BASEBAND

FIG. 3c



SPECTRUM OF AN FM NTSC SIGNAL NEAR VOICEBAND

FIG. 4


TO CONTROL SIGNAL PROCESSOR 420
FROM MASTER CONTROLLER 415
PROCESSOR 418
420b
LINKS 446a-446c
SIGNAL DISTRIBUTION SUBSYSTEM 403
478c
TO SIGNAL SEPARATORS 413
478a
478b
INTERFACE 409
SIGNAL COLLECTION SUBSYSTEM 407
479a
FROM SIGNAL SEPARATORS 413
479c
479b
COMMUNICATION LINE 402
LINKS 446d-446e
FROM MASTER CONTROLLER 415

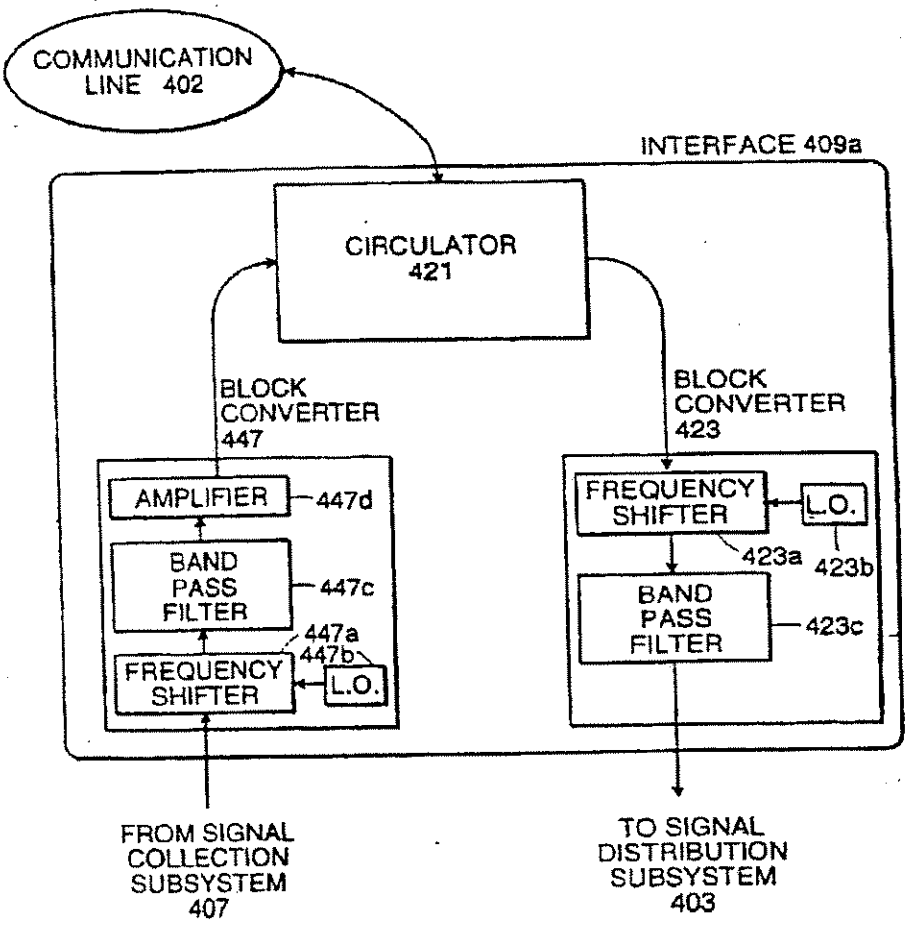

COMMUNICATION LINE 402
INTERFACE 409a
CIRCULATOR 421
BLOCK CONVERTER 447
AMPLIFIER
447d
BAND PASS FILTER
447c
447a
447b
FREQUENCY SHIFTER
L.O.
BLOCK CONVERTER 423
FREQUENCY SHIFTER
L.O.
423a
423b
BAND PASS FILTER
423c
FROM SIGNAL COLLECTION SUBSYSTEM 407
TO SIGNAL DISTRIBUTION SUBSYSTEM 403

FIG. 4a

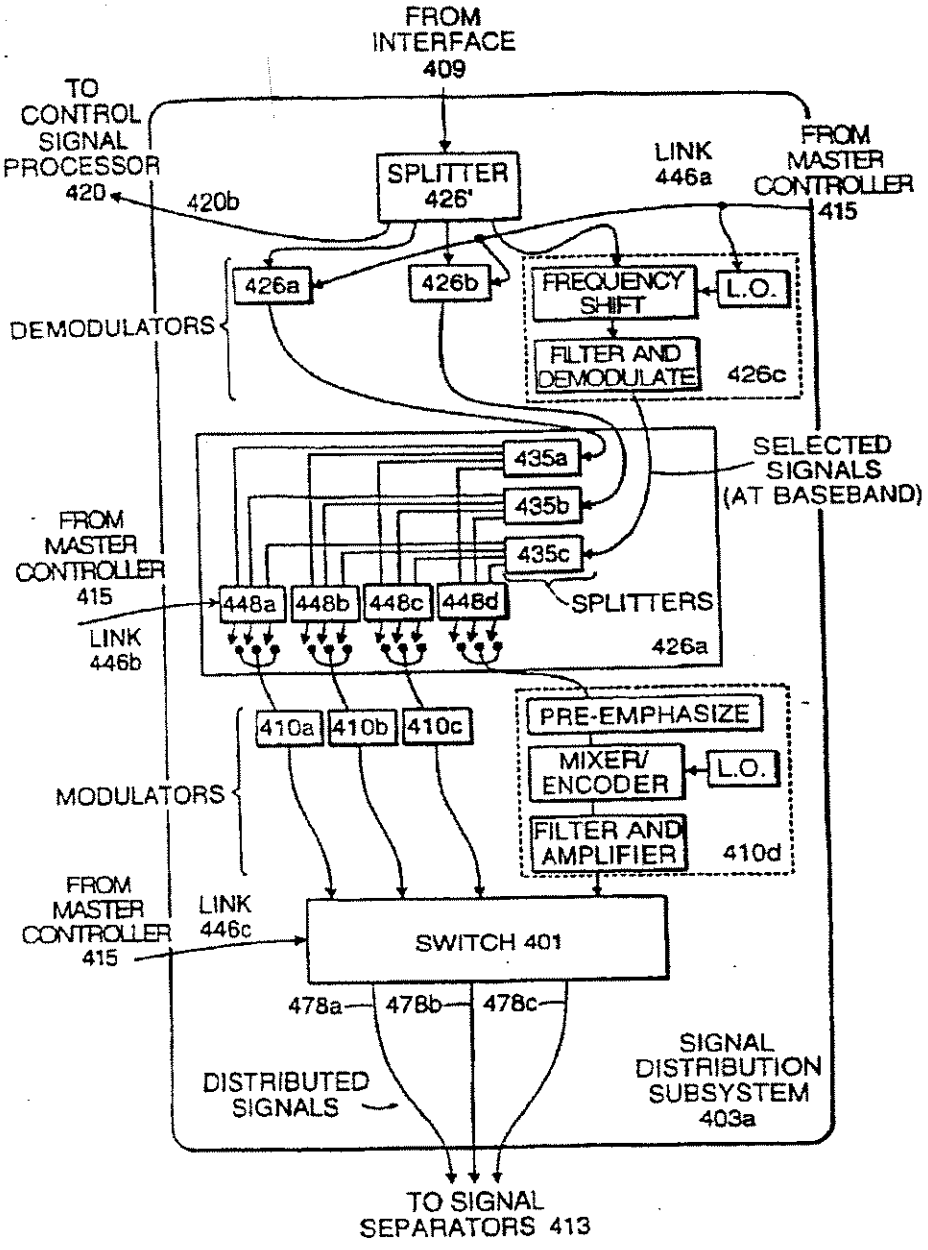

FROM INTERFACE 409
TO CONTROL SIGNAL PROCESSOR 420
420b
SPLITTER 426'
LINK 446a
FROM MASTER CONTROLLER 415
426a
426b
FREQUENCY SHIFT
L.O.
DEMODULATORS
FILTER AND DEMODULATE
426c
435a
435b
435c
SELECTED SIGNALS (AT BASEBAND)
FROM MASTER CONTROLLER 415
448a
448b
448c
448d
SPLITTERS
426a
LINK 446b
410a
410b
410c
PRE-EMPHASIZE
MIXER/ ENCODER
L.O.
MODULATORS
FILTER AND AMPLIFIER
410d
FROM MASTER CONTROLLER 415
LINK 446c
SWITCH 401
478a
478b
478c
DISTRIBUTED SIGNALS
SIGNAL DISTRIBUTION SUBSYSTEM 403a
TO SIGNAL SEPARATORS 413

FIG. 5a

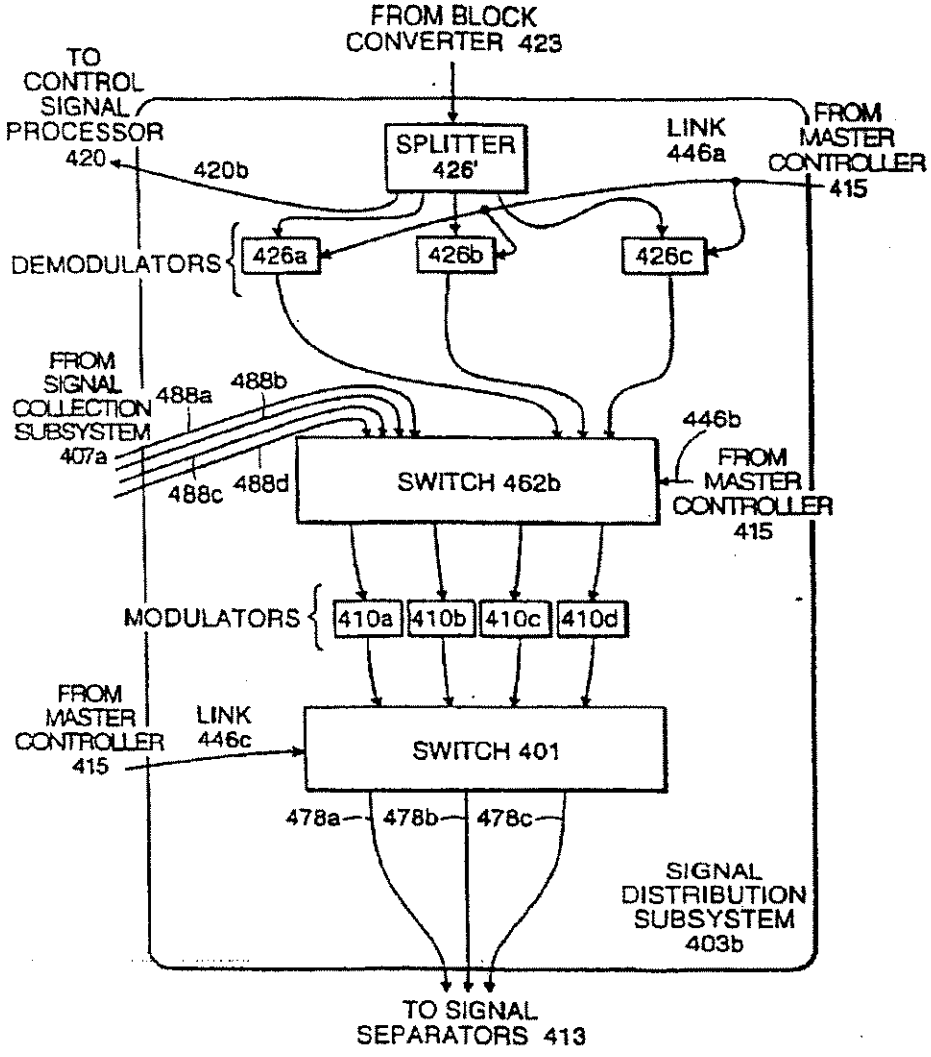

FROM BLOCK CONVERTER 423
TO CONTROL SIGNAL PROCESSOR 420
420b
SPLITTER 426'
LINK 446a
FROM MASTER CONTROLLER 415
DEMODULATORS
426a
426b
426c
FROM SIGNAL COLLECTION SUBSYSTEM 407a
488a
488b
488c
488d
446b
SWITCH 462b
FROM MASTER CONTROLLER 415
MODULATORS
410a
410b
410c
410d
FROM MASTER CONTROLLER 415
LINK 446c
SWITCH 401
478a
478b
478c
SIGNAL DISTRIBUTION SUBSYSTEM 403b
TO SIGNAL SEPARATORS 413

FIG. 5b

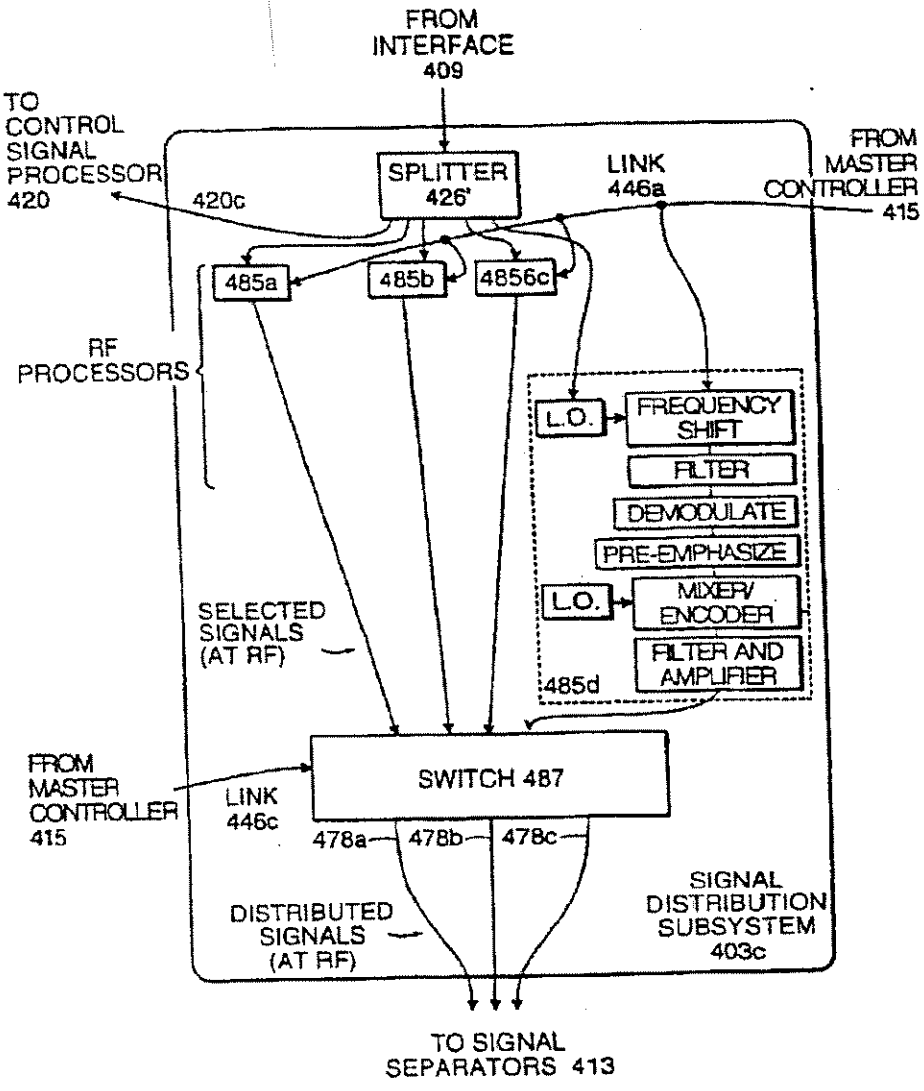

FROM INTERFACE 409
TO CONTROL SIGNAL PROCESSOR 420
420c
SPLITTER 426'
LINK 446a
FROM MASTER CONTROLLER 415
485a
485b
4856c
RF PROCESSORS
L.O.
FREQUENCY SHIFT
FILTER
DEMODULATE
PRE-EMPHASIZE
L.O.
MIXER/ ENCODER
FILTER AND AMPLIFIER
485d
SELECTED SIGNALS (AT RF)
FROM MASTER CONTROLLER 415
LINK 446c
SWITCH 487
478a
478b
478c
DISTRIBUTED SIGNALS (AT RF)
SIGNAL DISTRIBUTION SUBSYSTEM 403c
TO SIGNAL SEPARATORS 413

FIG. 5c

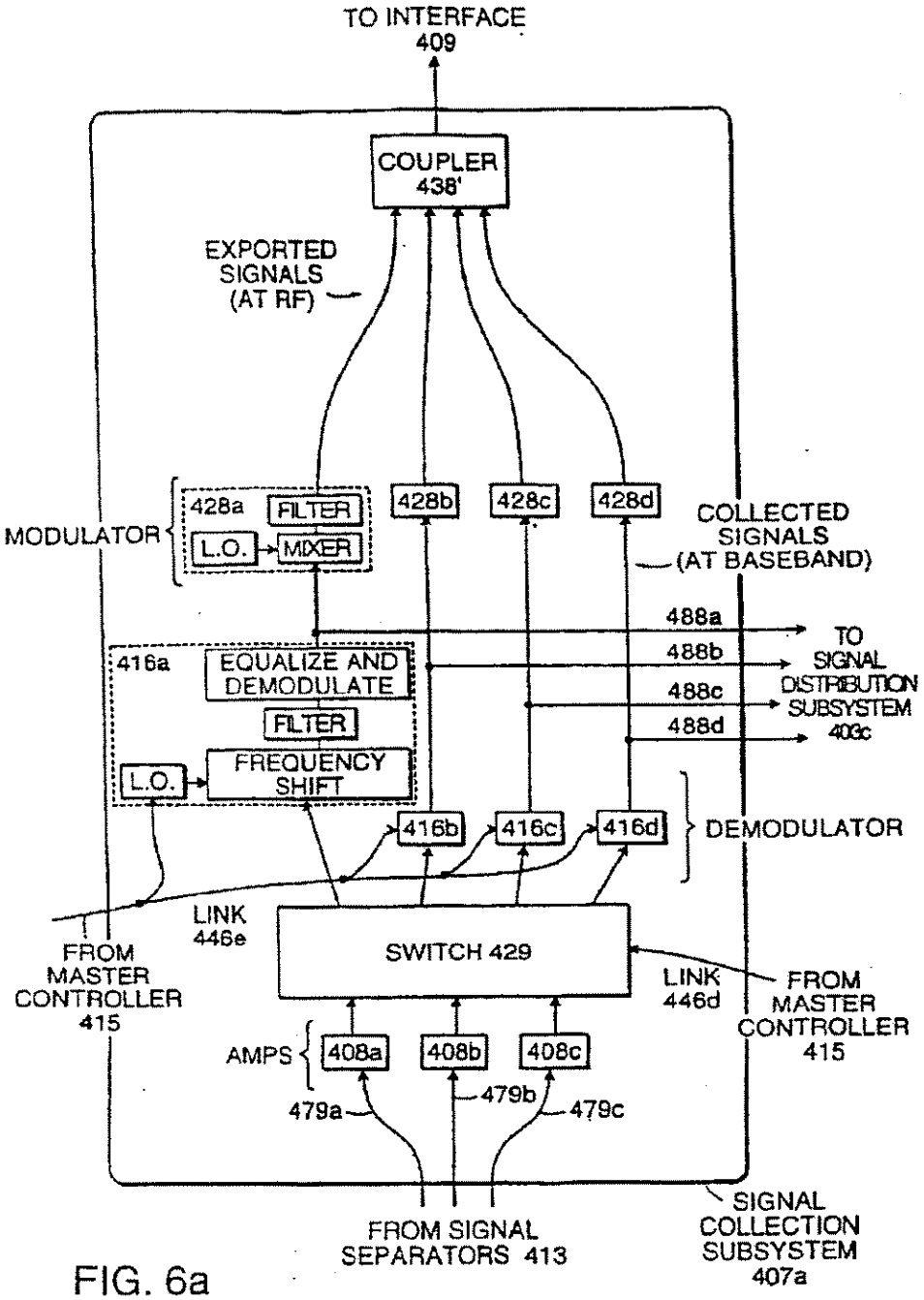

TO INTERFACE 409
COUPLER 438'
EXPORTED SIGNALS (AT RF)
MODULATOR
428a
FILTER
L.O.
MIXER
428b
428c
428d
COLLECTED SIGNALS (AT BASEBAND)
488a
488b
488c
488d
TO SIGNAL DISTRIBUTION SUBSYSTEM 409c
416a
EQUALIZE AND DEMODULATE
FILTER
L.O.
FREQUENCY SHIFT
416b
416c
416d
DEMODULATOR
LINK 446e
FROM MASTER CONTROLLER 415
SWITCH 429
LINK 446d
FROM MASTER CONTROLLER 415
AMPS
408a
408b
408c
479a
479b
479c
FROM SIGNAL SEPARATORS 413
SIGNAL COLLECTION SUBSYSTEM 407a

FIG. 6a

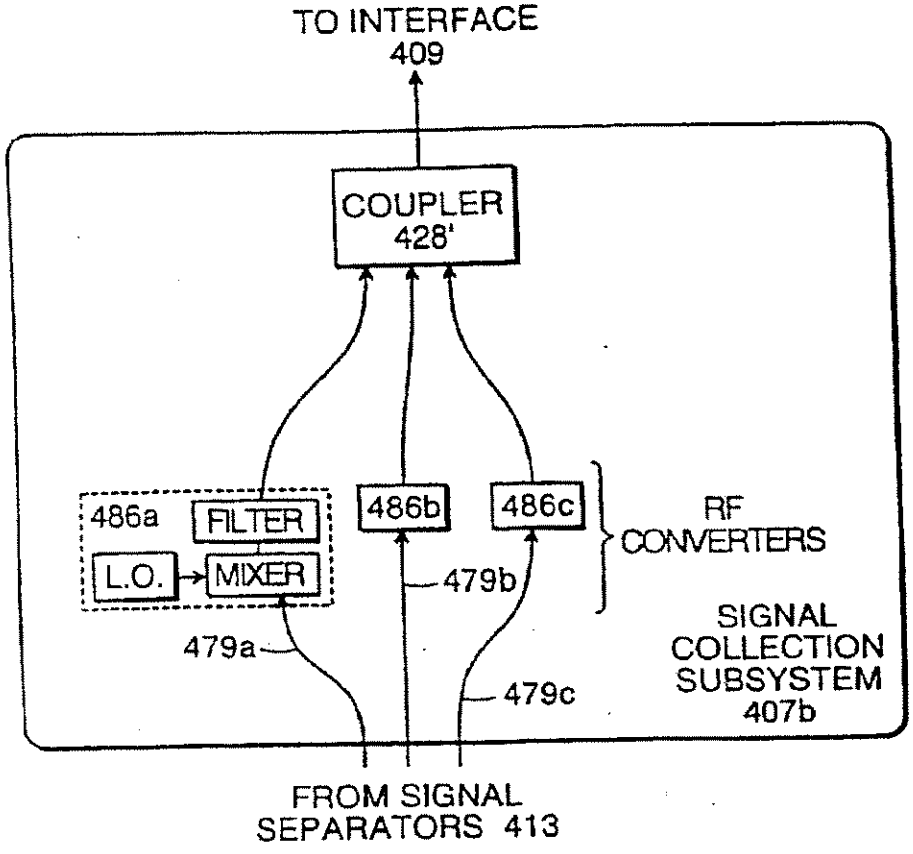

TO INTERFACE
409
COUPLER
428'
486a
FILTER
L.O.
MIXER
486b
486c
RF
CONVERTERS
479b
479a
479c
SIGNAL
COLLECTION
SUBSYSTEM
407b
FROM SIGNAL
SEPARATORS 413

FIG. 6b

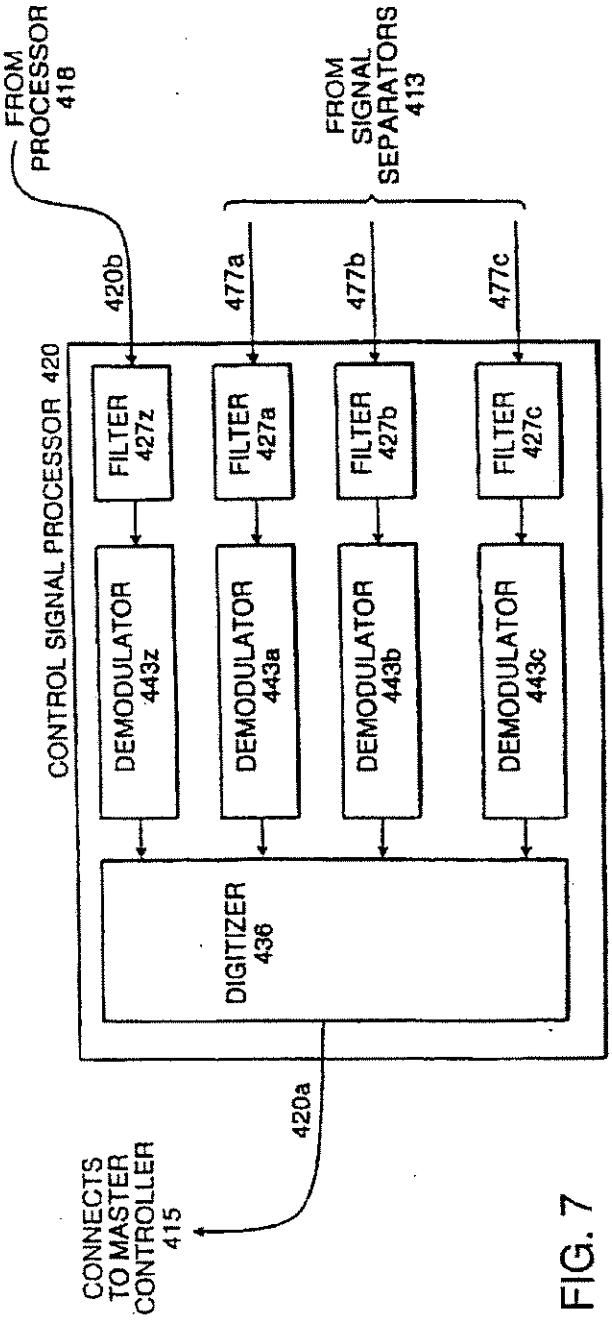

FROM PROCESSOR 418
FROM SIGNAL SEPARATORS 413
420b
477a
477b
477c
CONTROL SIGNAL PROCESSOR 420
FILTER 427z
FILTER 427a
FILTER 427b
FILTER 427c
DEMODULATOR 443z
DEMODULATOR 443a
DEMODULATOR 443b
DEMODULATOR 443c
DIGITIZER 436
420a
CONNECTS TO MASTER CONTROLLER 415

FIG. 7

FIG. 8

	ORIGIN/DEST	FREQUENCY DURING TRANSMISSION OVER EXTENDED PAIRS (MHz)				FREQUENCY DURING TRANSMISSION OVER LOCAL NETWORKS (MHz)		
		405a	405b	405c	411a	411b	411c
CONTROL A	493a/415	22.75-23.25			22.75-23.25		
B	493b/415		22.75-23.25			22.75-23.25	
C	493c/415			22.75-23.25			22.75-23.25
VIDEO U	402/492a	1-6(AM)			12-18(AM)		
V	402/492b 492c 498a	7-22(FM)	1-6(AM)	1-6(AM)	24-30(AM)	54-60(AM)	12-18(AM)
W	494b/402		24-54(FM)			6-12(AM)	
X	494c/402			24-54(FM)			6-12(AM)
DIGITAL Y	402/495c			6-18			18-40
Z	495c/402			54-100			1-6

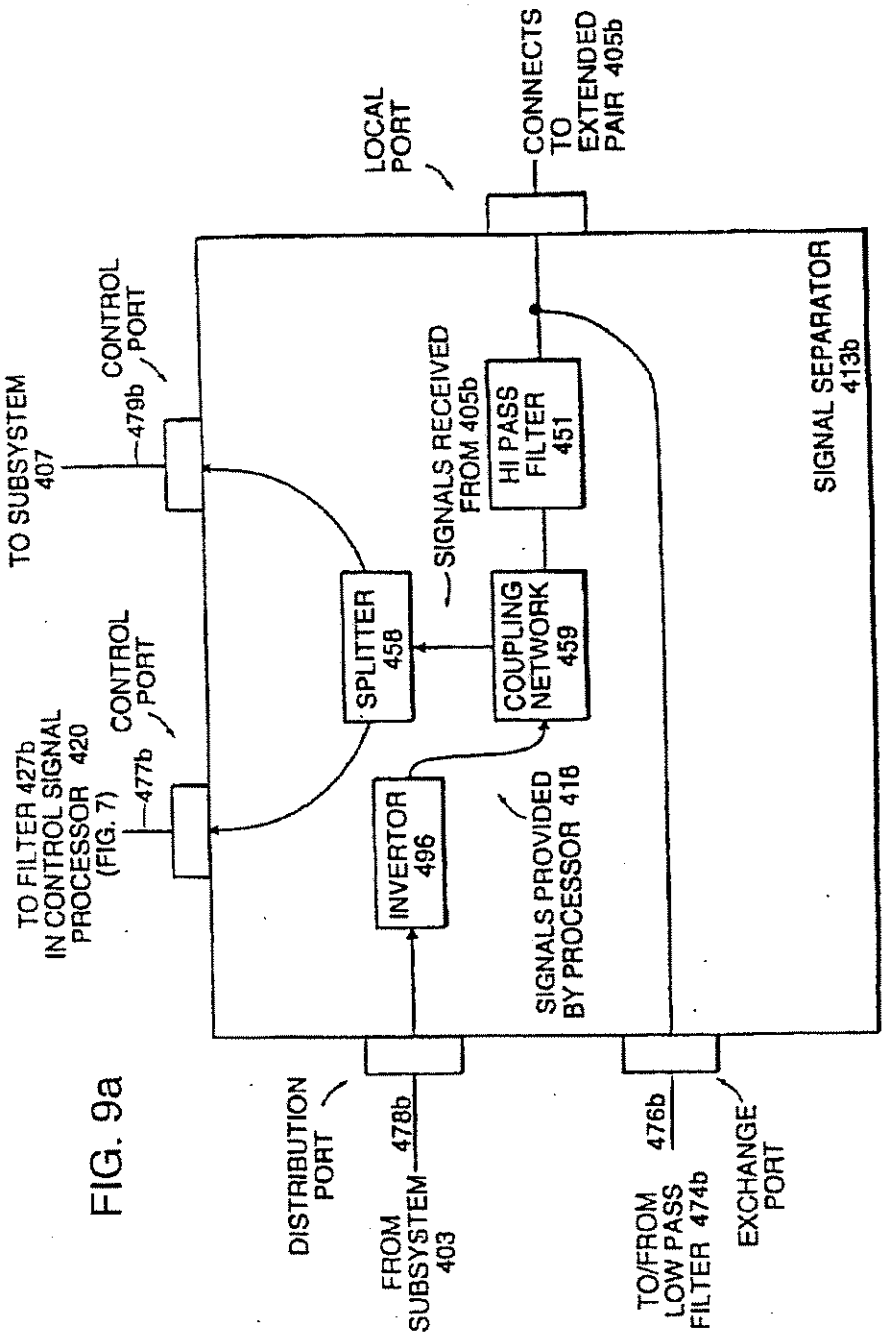

LOCAL PORT
CONNECTS TO EXTENDED PAIR 405b
SIGNAL SEPARATOR 413b
CONTROL PORT 479b
TO SUBSYSTEM 407
HI PASS FILTER 451
SIGNALS RECEIVED FROM 405b
SPLITTER 458
COUPLING NETWORK 459
CONTROL PORT 477b
TO FILTER 427b IN CONTROL SIGNAL PROCESSOR 420 (FIG. 7)
INVERTOR 496
SIGNALS PROVIDED BY PROCESSOR 418
DISTRIBUTION PORT
478b
FROM SUBSYSTEM 403
476b
TO/FROM LOW PASS FILTER 474b
EXCHANGE PORT

FIG. 9a

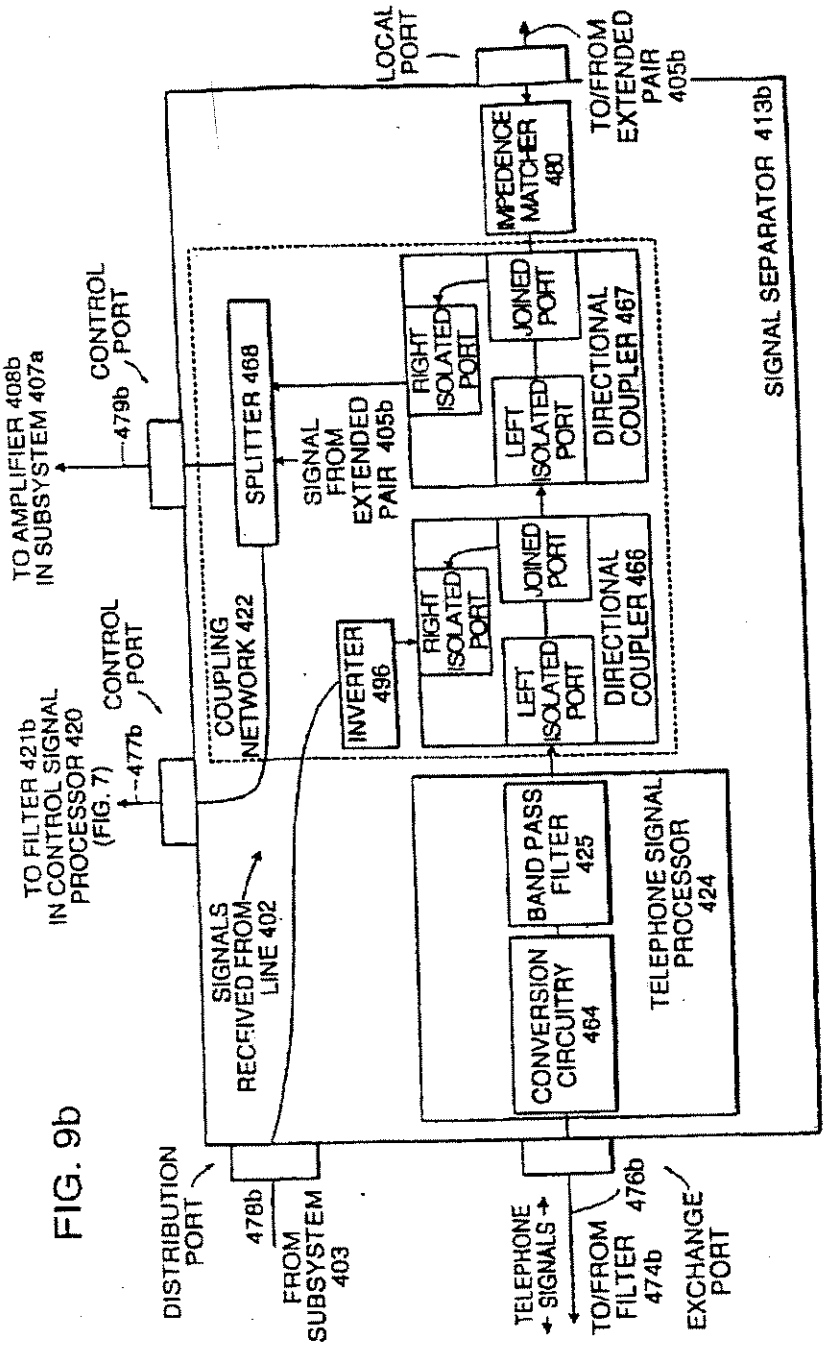

LOCAL PORT
TO/FROM EXTENDED PAIR 405b
IMPEDENCE MATCHER 480
SIGNAL SEPARATOR 413b
TO AMPLIFIER 408b IN SUBSYSTEM 407a
CONTROL PORT 479b
SPLITTER 468
SIGNAL FROM EXTENDED PAIR 405b
RIGHT ISOLATED PORT
JOINED PORT
LEFT ISOLATED PORT
DIRECTIONAL COUPLER 467
RIGHT ISOLATED PORT
JOINED PORT
LEFT ISOLATED PORT
DIRECTIONAL COUPLER 466
INVERTER 496
COUPLING NETWORK 422
TO FILTER 421b IN CONTROL SIGNAL PROCESSOR 420 (FIG. 7)
CONTROL PORT 477b
SIGNALS RECEIVED FROM LINE 402
BAND PASS FILTER 425
CONVERSION CIRCUITRY 464
TELEPHONE SIGNAL PROCESSOR 424
DISTRIBUTION PORT
478b
FROM SUBSYSTEM 403
TELEPHONE SIGNALS
TO/FROM FILTER 474b
476b
EXCHANGE PORT

FIG. 9b

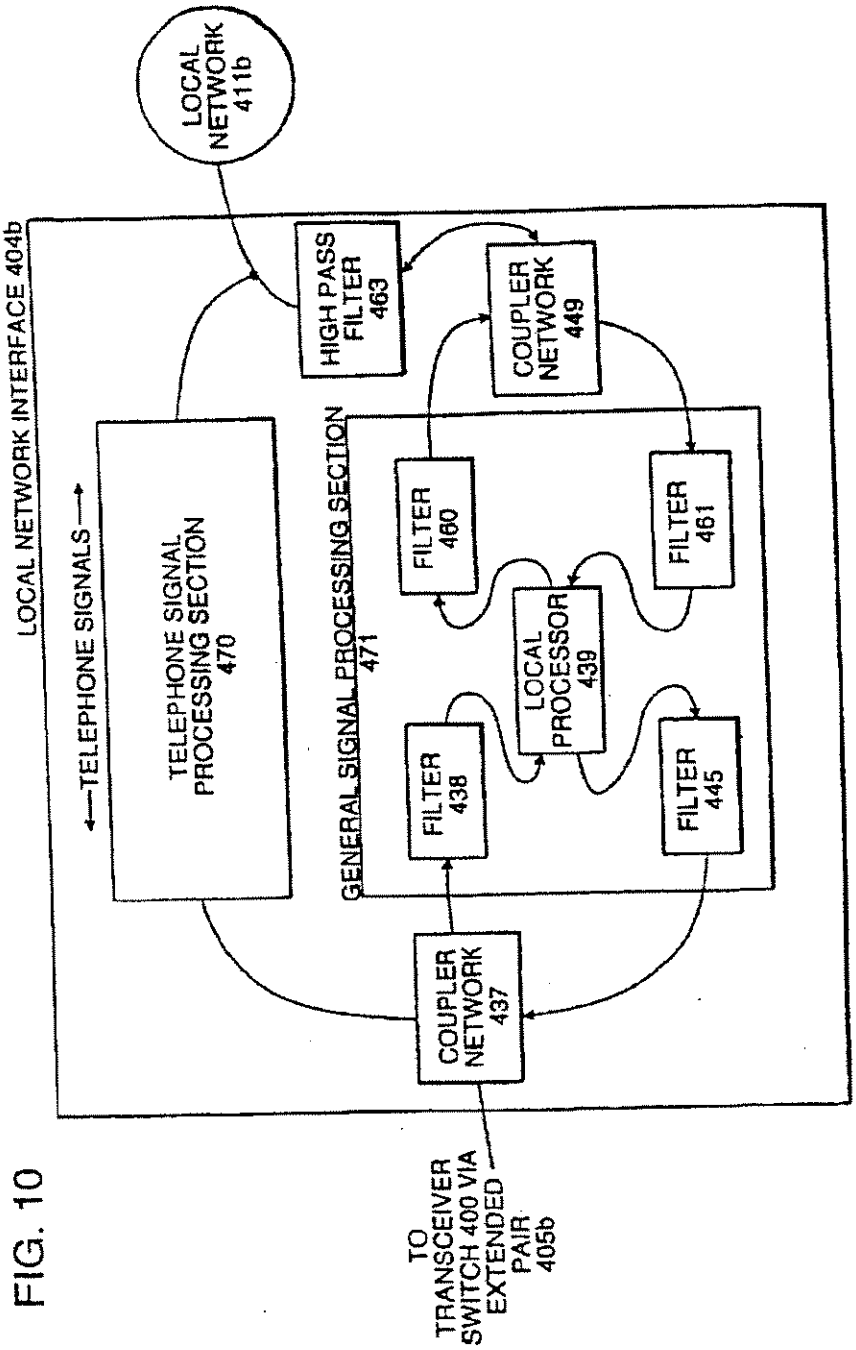

LOCAL NETWORK 411b
LOCAL NETWORK INTERFACE 404b
HIGH PASS FILTER 463
COUPLER NETWORK 449
TELEPHONE SIGNALS
TELEPHONE SIGNAL PROCESSING SECTION 470
GENERAL SIGNAL PROCESSING SECTION 471
FILTER 460
FILTER 461
LOCAL PROCESSOR 439
FILTER 438
FILTER 445
COUPLER NETWORK 437
TO TRANSCEIVER SWITCH 400 VIA EXTENDED PAIR 405b

FIG. 10

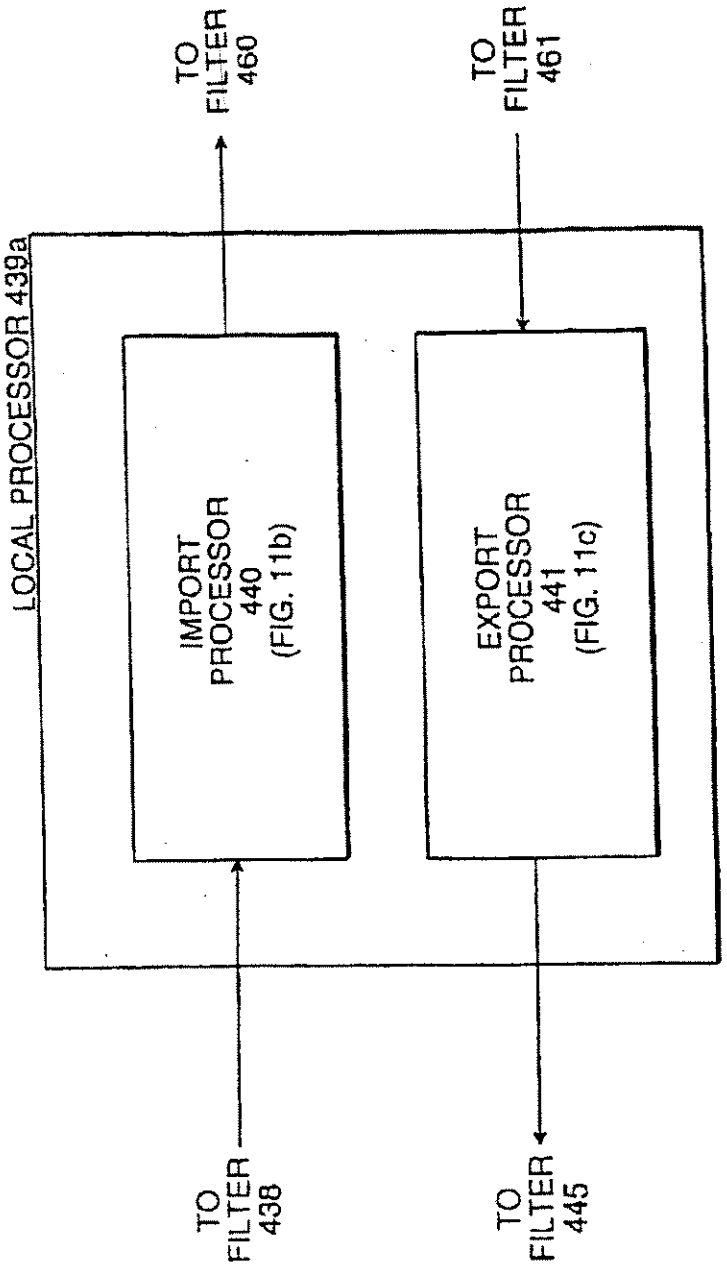

TO FILTER 460
TO FILTER 461
LOCAL PROCESSOR 439a
IMPORT PROCESSOR 440 (FIG. 11b)
EXPORT PROCESSOR 441 (FIG. 11c)
TO FILTER 438
TO FILTER 445

FIG. 11a

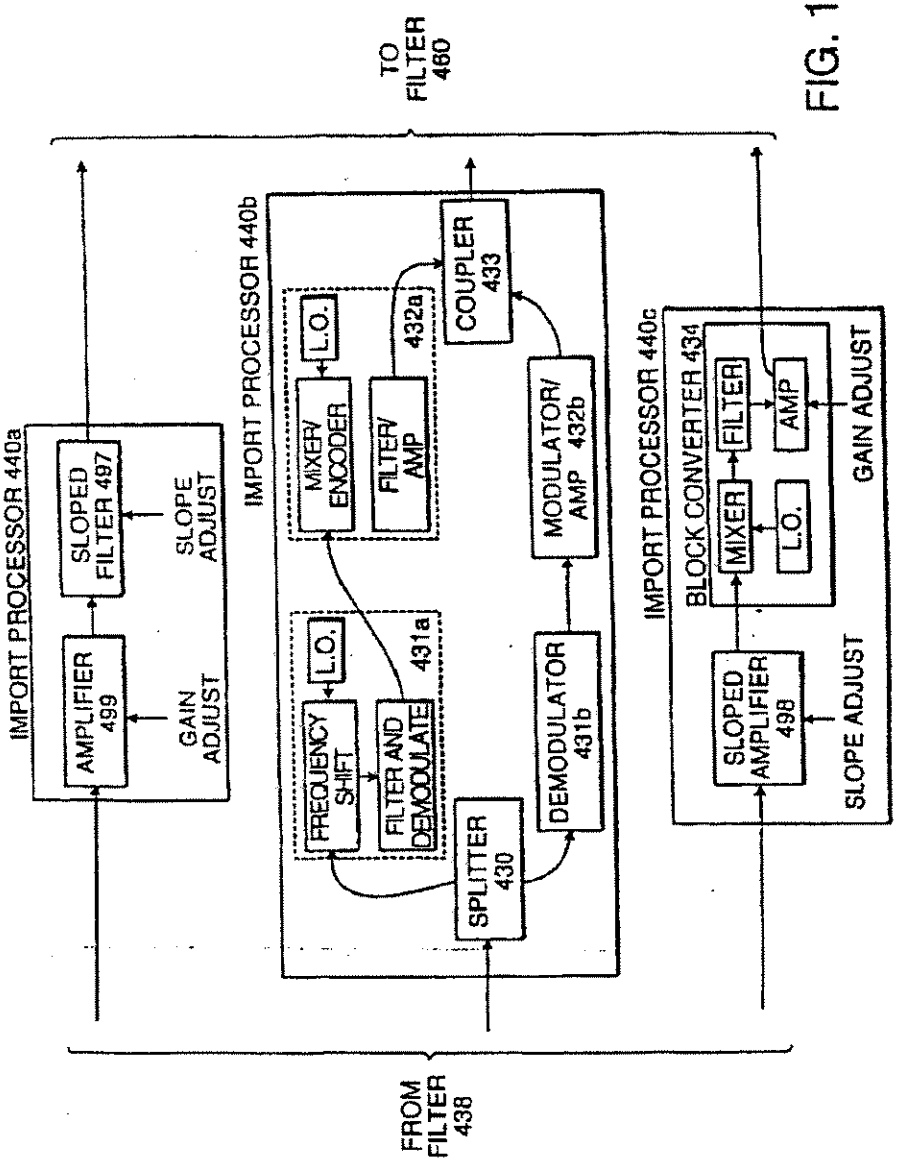

TO FILTER 460
IMPORT PROCESSOR 440a
SLOPED FILTER 497
SLOPE ADJUST
AMPLIFIER 499
GAIN ADJUST
IMPORT PROCESSOR 440b
L.O.
MIXER/ ENCODER
FILTER/ AMP
432a
COUPLER 433
MODULATOR/ AMP 432b
L.O.
FREQUENCY SHIFT
FILTER AND DEMODULATE
431a
DEMODULATOR 431b
SPLITTER 430
IMPORT PROCESSOR 440c
BLOCK CONVERTER 434
MIXER
L.O.
FILTER
AMP
GAIN ADJUST
SLOPED AMPLIFIER 498
SLOPE ADJUST
FROM FILTER 438

FIG. 11b

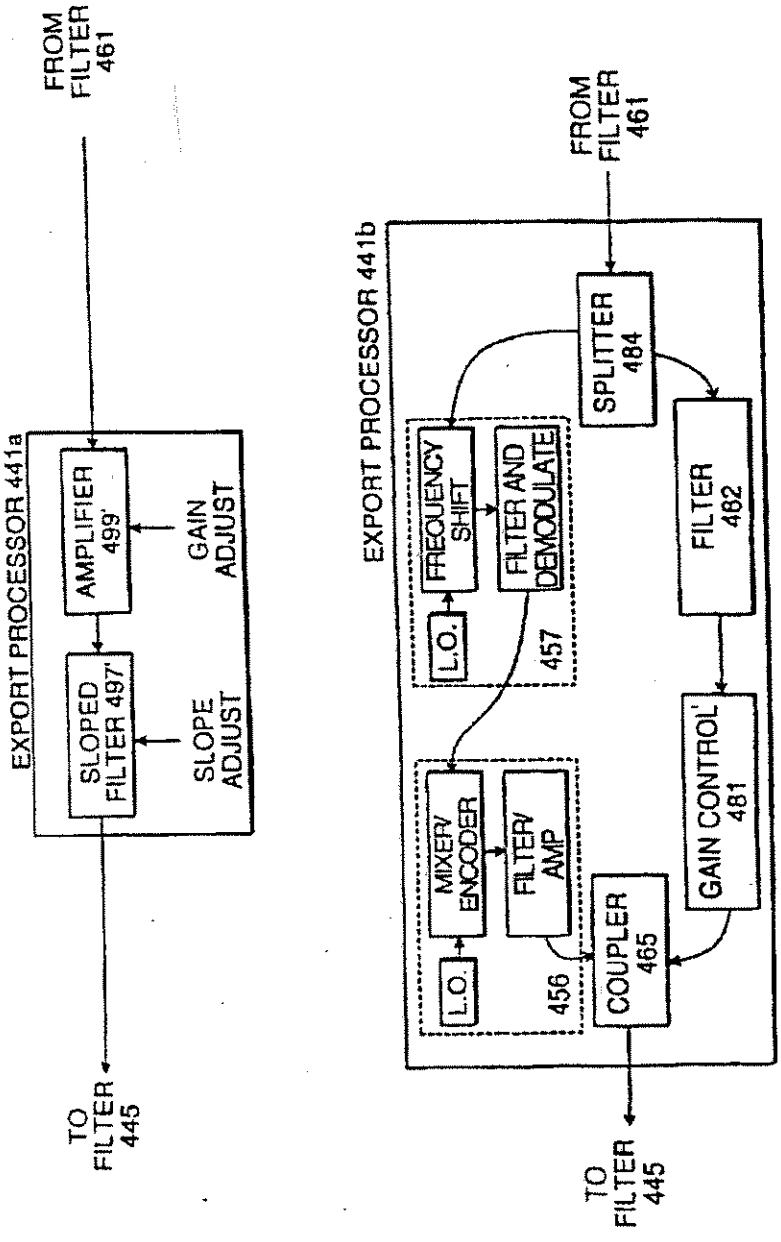

FROM FILTER 461
EXPORT PROCESSOR 441a
AMPLIFIER 499'
GAIN ADJUST
SLOPED FILTER 497'
SLOPE ADJUST
TO FILTER 445
FROM FILTER 461
EXPORT PROCESSOR 441b
SPLITTER 484
FREQUENCY SHIFT
FILTER AND DEMODULATE
L.O.
457
FILTER 482
MIXER/ ENCODER
FILTER/ AMP
L.O.
456
COUPLER 465
GAIN CONTROL 481
TO FILTER 445

FIG. 11c

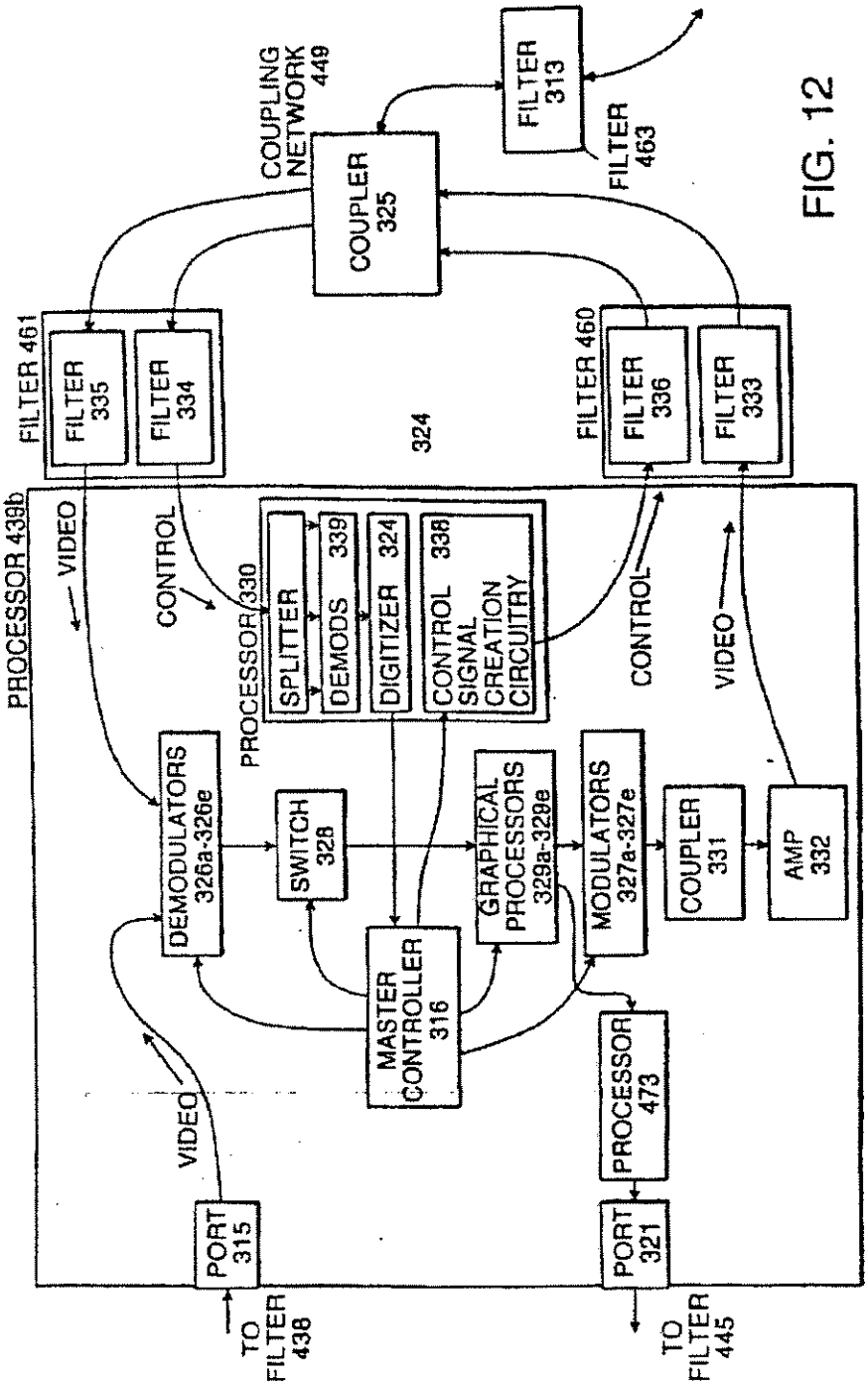

COUPLING NETWORK 449
COUPLER 325
FILTER 313
FILTER 463
FILTER 461
FILTER 335
FILTER 334
FILTER 460
FILTER 336
FILTER 333
324
PROCESSOR 439b
VIDEO
CONTROL
PROCESSOR 330
SPLITTER
DEMODS 339
DIGITIZER 324
CONTROL SIGNAL CREATION CIRCUITRY 338
CONTROL
VIDEO
DEMODULATORS 326a-326e
SWITCH 328
GRAPHICAL PROCESSORS 329a-329e
MODULATORS 327a-327e
COUPLER 331
AMP 332
MASTER CONTROLLER 316
PROCESSOR 473
VIDEO
PORT 315
PORT 321
TO FILTER 438
TO FILTER 445

FIG. 12

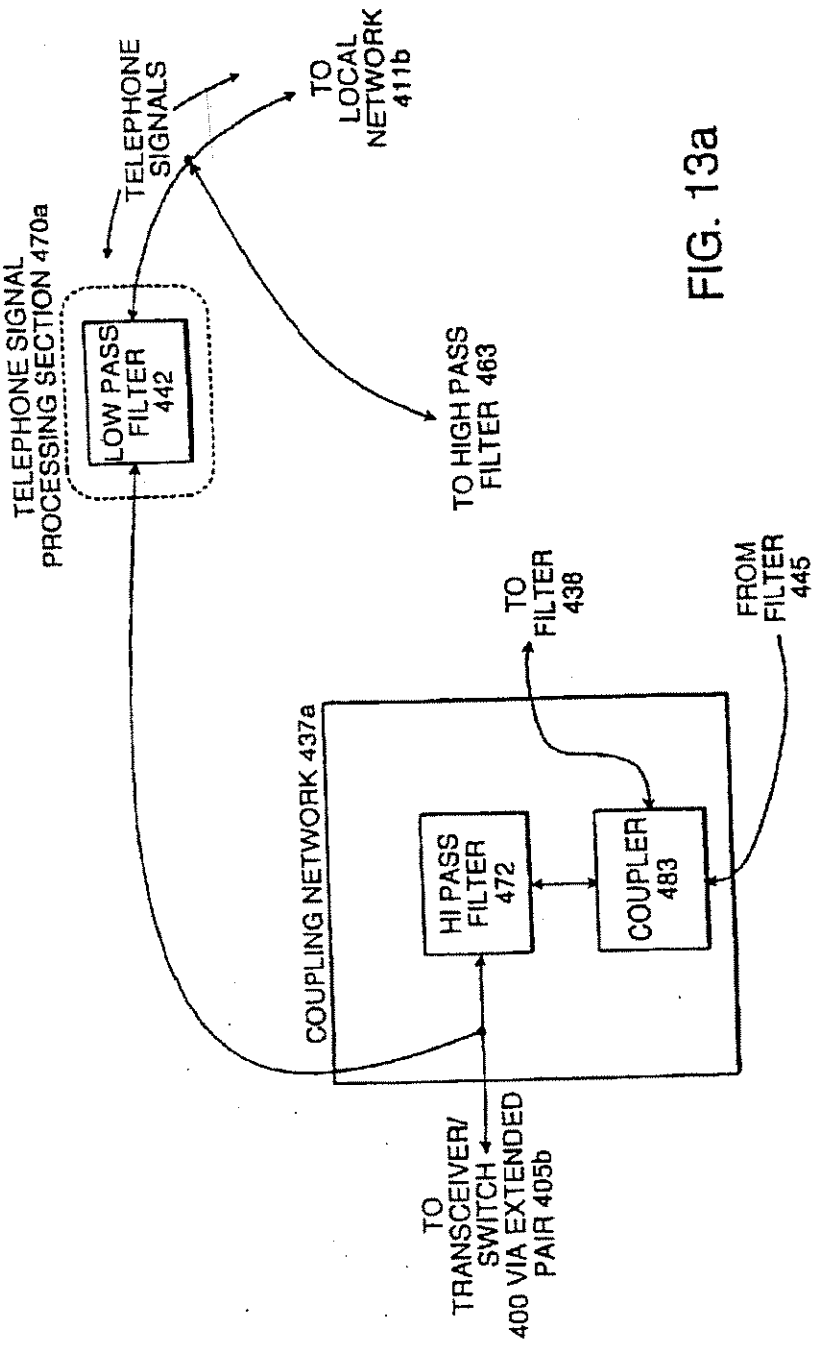

TELEPHONE SIGNALS
TO LOCAL NETWORK 411b
TELEPHONE SIGNAL PROCESSING SECTION 470a
LOW PASS FILTER 442
TO HIGH PASS FILTER 463
TO FILTER 438
FROM FILTER 445
COUPLING NETWORK 437a
HI PASS FILTER 472
COUPLER 483
TO TRANSCEIVER/ SWITCH 400 VIA EXTENDED PAIR 405b

FIG. 13a

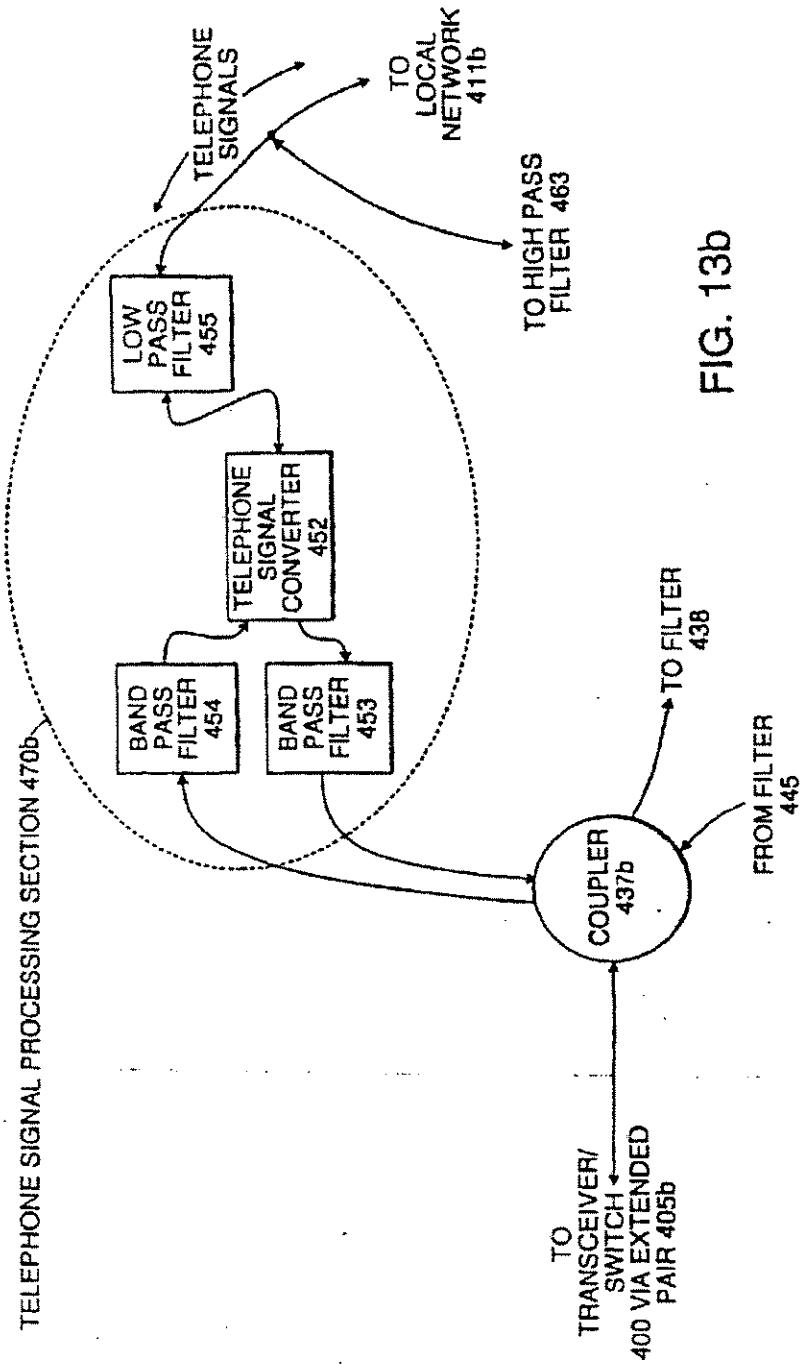

TELEPHONE SIGNALS
TO LOCAL NETWORK 411b
TO HIGH PASS FILTER 463
LOW PASS FILTER 455
TELEPHONE SIGNAL CONVERTER 452
BAND PASS FILTER 454
BAND PASS FILTER 453
TELEPHONE SIGNAL PROCESSING SECTION 470b
TO FILTER 438
FROM FILTER 445
COUPLER 437b
TO TRANSCEIVER/ SWITCH 400 VIA EXTENDED PAIR 405b

FIG. 13b

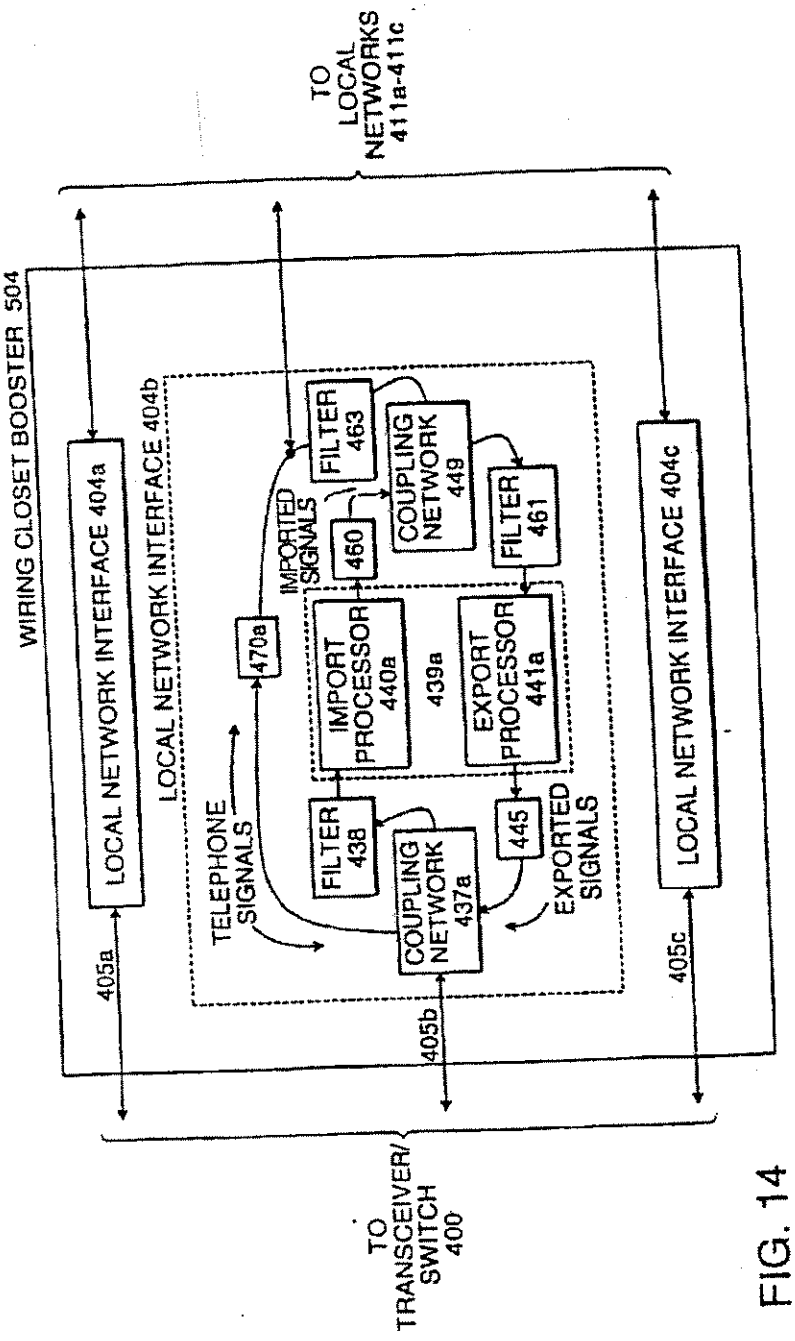

TO LOCAL NETWORKS 411a-411c
WIRING CLOSET BOOSTER 504
LOCAL NETWORK INTERFACE 404a
LOCAL NETWORK INTERFACE 404b
LOCAL NETWORK INTERFACE 404c
FILTER 463
COUPLING NETWORK 449
FILTER 461
IMPORTED SIGNALS
460
470a
IMPORT PROCESSOR 440a
439a
EXPORT PROCESSOR 441a
TELEPHONE SIGNALS
FILTER 438
COUPLING NETWORK 437a
445
EXPORTED SIGNALS
405a
405b
405c
TO TRANSCEIVER/ SWITCH 400

FIG. 14

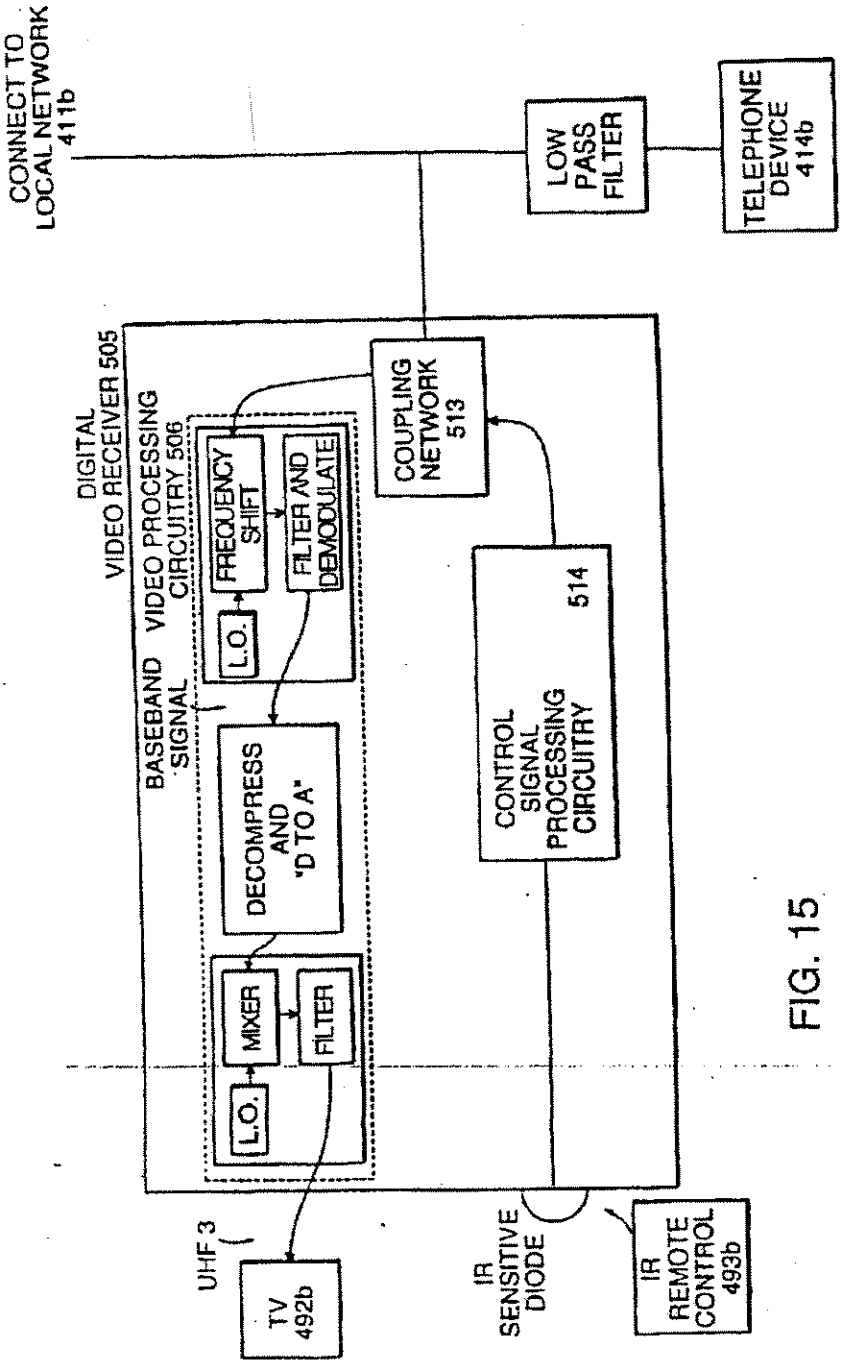
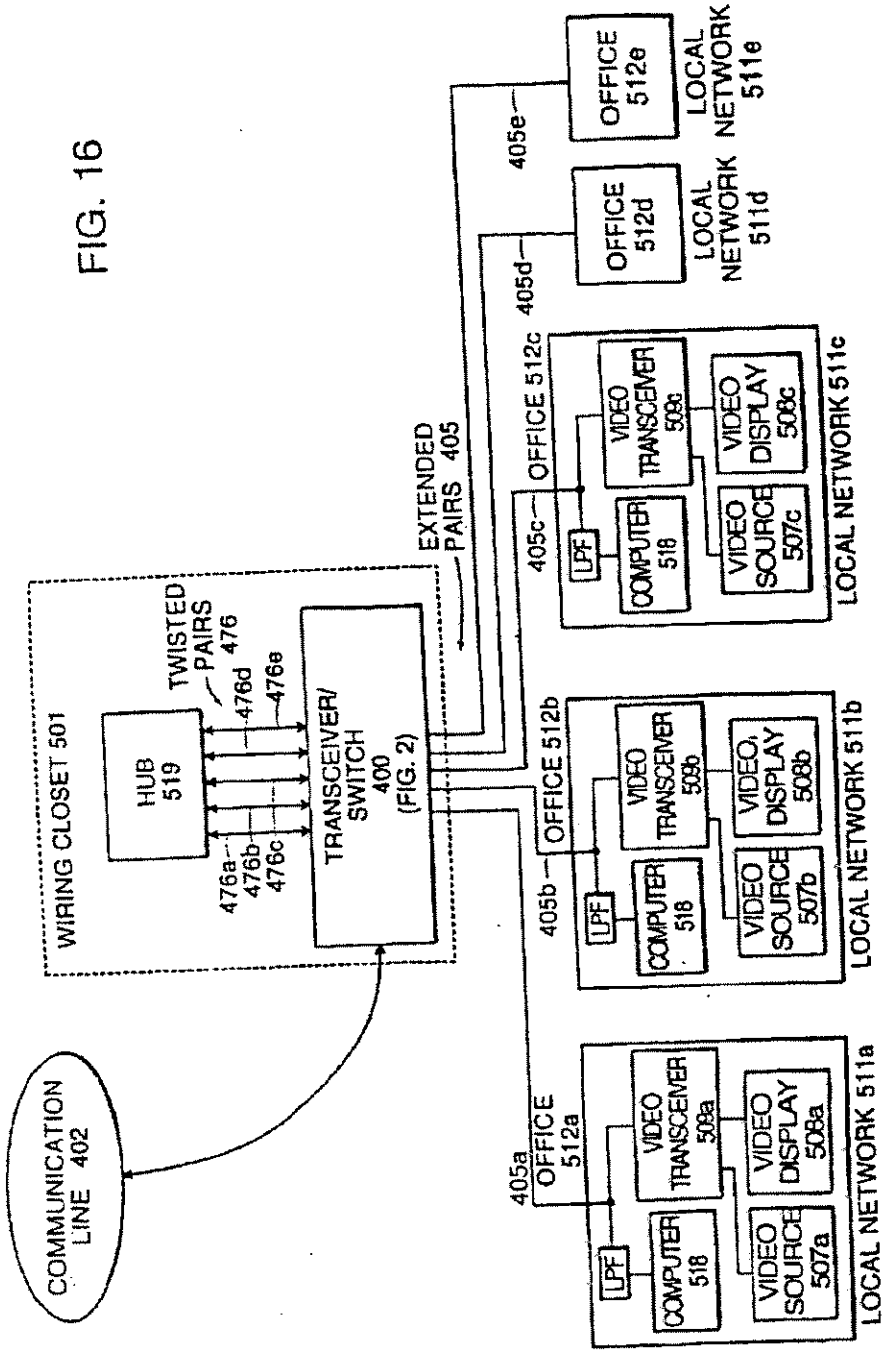

CONNECT TO LOCAL NETWORK 411b
LOW PASS FILTER
TELEPHONE DEVICE 414b
DIGITAL VIDEO RECEIVER 505
VIDEO PROCESSING CIRCUITRY 506
COUPLING NETWORK 513
FREQUENCY SHIFT
FILTER AND DEMODULATE
L.O.
BASEBAND SIGNAL
DECOMPRESS AND "D TO A"
CONTROL SIGNAL PROCESSING CIRCUITRY 514
MIXER
FILTER
L.O.
UHF 3
TV 492b
IR SENSITIVE DIODE
IR REMOTE CONTROL 493b

FIG. 15

FIG. 16


WIRING CLOSET 501
HUB 519
TWISTED PAIRS 476
476a
476b
476c
476d
476e
TRANSCEIVER/ SWITCH 400 (FIG. 2)
EXTENDED PAIRS 405
COMMUNICATION LINE 402
405a
405b
405c
405d
405e
OFFICE 512a
OFFICE 512b
OFFICE 512c
OFFICE 512d
OFFICE 512e
LOCAL NETWORK 511a
LOCAL NETWORK 511b
LOCAL NETWORK 511c
LOCAL NETWORK 511d
LOCAL NETWORK 511e
VIDEO TRANSCEIVER 508a
VIDEO TRANSCEIVER 508b
VIDEO TRANSCEIVER 508c
VIDEO DISPLAY 508a
VIDEO DISPLAY 508b
VIDEO DISPLAY 508c
VIDEO SOURCE 507a
VIDEO SOURCE 507b
VIDEO SOURCE 507c
COMPUTER 518
LPF